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THE JOURNAL
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VOL. XV JANUARY, 1921 No. 1

ORBIT OF THE SPECTROSCOPIC BINARY H. R. 8427

BY REYNOLD K. YOUNG

The binary character of the star, (1900 R.A. 22h 02m.0, Decl. +47° 45′, Mag. 6.2,) was announced by the writer in 1919. At that time it was noticed that the H and K lines of calcium seemed to give nearly constant velocities and further observations have been made to investigate this and to determine the orbital elements.

The spectrum is classified as of type A in the Revised Harvard Photometry, *H.A.* Volume 50, but the later Draper Catalogue gives it as B3. The spectra taken here seem to show approximately the latter type or possibly B2, for the carbon line 4267 is quite strong. The lines are of rather poor quality and the calcium lines, usually so sharp and narrow in spectra where they do not shift with the other lines, are not very good. They are, however, better than the other lines. The velocities resulting from them are not included in the mean. In the table of 32 observations below they are listed under the heading "K line". In general the K line alone was measured, but sometimes when the shift of the neighbouring H_ϵ line permitted, the H line could be measured also and in these cases the given velocity is the mean of the two lines.

The observations extend over an interval of 424 days, four plates being taken in 1918 and the remainder in 1919. The earlier plates were made use of only in determining the period. This was fixed at 2.1722 days and not included in a least squares solution made for the elements. It sometimes happens that a period determined in

this way needs to be modified slightly after the shape of the curve and its phase is rigidly determined and such is the case in the present instance. A period 2.1721 days will harmonize the early observations with the final curve better than 2.1722. The former period

Plate	Date	Julian Date G.M.T.	Phase	Velocity	Lines	Wt.	K Line	Residuals O−C
348	1918 July 12	2,421,787.918	1.81	−143.0	5		+ 1.3	+ 2.0
438	Aug. 5	1,811.876	1.88	−126.9	6		− 3.0	+14.1
624	Sept. 16	1,853.747	0.30	+ 10.6	2		+32.3	−18.4
848	Nov. 4	1,902.676	1.45	− 82.1	6	1	+ 6.7	+ 1.9
2151	1919 June 17	2,127.954	0.812	+116.1	6	1	− 3.5	+14.1
2201	" 28	2,138.950	0.950	+ 81.7	6	1	+40.8	+ 1.7
2215	" 29	2,139.948	1.948	−140.5	7	1	− 2.1	− 9.0
2231	" 30	2,140.953	0.782	+100.4	6	1	+ 2.5	+ 5.6
2246	July 1	2,141.952	1.781	−166.2	5	1	+ 8.8	−21.0
2260	" 2	2,142.955	0.613	+ 93.8	7	1	+ 1.2	−10.0
2272	" 3	2,143.945	1.603	−129.6	6	1	−13.4	− 5.6
2287	" 6	2,146.948	0.261	+ 10.2	6	1	− 5.6	− 3.8
2304	" 7	2,147.960	1.273	− 25.7	6	1	+ 2.2	− 3.7
2318	" 8	2,148.936	0.079	− 39.9	6	1	+ 0.2	+14.0
2330	" 9	2,149.890	1.033	+ 41.5	5	1	+ 7.5	−17.5
2334	" 9	2,149.961	1.104	+ 27.9	6	1	− 1.5	− 7.0
2359	" 13	2,153.943	0.743	+116.9	4	1	+ 5.2	+ 9.0
2394	" 15	2,155.945	0.571	+101.0	4	1	+ 8.1	+ 1.0
2430	" 18	2,158.922	1.379	− 51.6	6	1	+ 2.1	+10.4
2444	" 19	2,159.957	0.242	+ 0.6	6	1	+ 4.1	− 7.0
2462	" 20	2,160.940	1.225	− 6.2	8	1	− 1.0	+ 0.0
2481	" 21	2,161.966	0.080	− 44.3	6	1	+12.2	+ 6.7
2500	" 22	2,162.947	1.061	+ 68.9	6	1	− 0.3	+19.0
2520	" 23	2,163.939	2.053	−123.4	5	1	+ 6.5	−11.4
2565	" 28	2,168.904	0.493	+ 90.6	3	1	.....	+ 5.6
2592	" 30	2.170.960	0.377	+ 54.9	4	1	− 3.5	− 1.0
2619	Aug. 7	2.178.908	1.808	−141.0	5	1	−17.4	+ 4.0
2631	" 9	2,422,180.899	1.627	−128.0	5	1	+ 0.9	+ 4.0
2809	" 22	2,193.864	1.559	− 99.4	5	1	+20.0	+15.6
2865	" 29	2,200.832	2.010	−132.5	5	1	+ 4.1	−11.0
2912	Sept. 9	2,211.774	2.091	− 96.0	6	1	− 0.3	+ 6.0
2913	1919 " 9	2,422,211.788	2.105	− 79.4	5	½	+ 1.1	+18.6

is taken as final. The observations were grouped into the following 14 normal places and preliminary elements selected upon which to base a least squares solution.

It seemed fruitless to attempt to solve for the eccentricity as the observations fitted a circular orbit very well. The element corresponding to periastron passage was taken as the instant when

	Mean Phase from J.D. 2,422,138.0	Mean Velocity	Number of Plates	Weight	Residuals O−C	
					Prel.	Final
1	0.079	− 42.1	2	1	+ 9.7	+9.9
2	0.251	+ 5.4	2	1	− 7.3	−5.6
3	0.377	+ 54.9	1	½	− 1.3	+1.4
4	0.493	+ 90.6	1	½	+ 2.8	+6.2
5	0.592	+ 97.4	2	1	− 8.2	−4.5
6	0.779	+111.1	3	1½	− 0.3	+3.3
7	0.992	+ 61.6	2	1	−12.0	−9.7
8	1.082	+ 48.4	2	1	+ 2.2	+3.7
9	1.249	− 16.0	2	1	− 1.8	−1.8
10	1.379	− 51.6	1	½	+10.9	+9.8
11	1.596	−119.0	3	1½	+ 7.1	+4.5
12	1.794	−153.6	2	1	− 5.3	−8.2
13	1.979	−136.5	2	1	− 5.4	−7.5
14	2.078	−103.6	2½	1	+ 4.6	+3.2

the velocity curve crosses the γ − axis while changing from a negative to a positive value. In this case the formulae for the least squares solution become

$$\mu = 2\pi/P \qquad v = \mu t$$
$$V_0 = \gamma + K \sin v$$
$$dV_0 = d\gamma + \sin v\, dK - K\mu \cos v\, dT$$

The final elements are given below

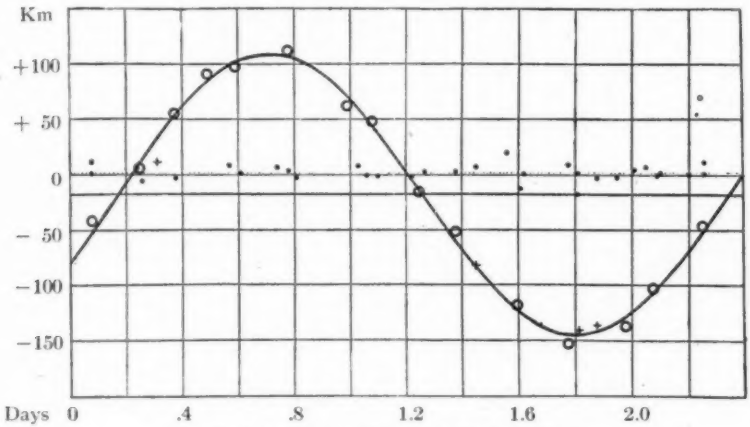
Period	P = 2.1721 days
Eccentricity	e = 0.0 (assumed)
Velocity of system	γ = −17.76 km.
Semi-amplitude	K = 127.7 km.
Perihelion passage	T = J.D. 2,422,138.172
	$a \sin i$ = 3,810,000 km.

$$\frac{m_1^3 \sin^3 i}{(m+m_1)^2} = 0.47 \odot$$

The results of the representation by the final elements as well as those for the preliminary will be found in the table of normal places. The Σpv^2 for the preliminary elements is 585 and for the final 509. The residuals computed from the observation equations agree very closely with the final ephemeris so that there can be no doubt of the sufficiency of the solution. The residuals for the

individual measures are given in the table of observations under the heading O−C. They are quoted to tenths of kilometers but are certainly not so accurately determined for they were scaled off the final graph which is shown herewith. The probable error of a single plate came out ± 7.0 km.

The result for the calcium lines is interesting. So far as the accuracy of measurement will allow they yield a constant velocity of+1.5 km. The velocity of the centre of gravity of the system



Radial Velocity Curve of H. R. 8427

is −17.8, while the velocity of the system toward the earth due to the sun's motion is about −14. In most of the cases of the fixed calcium lines which have hitherto been investigated the calcium has yielded velocities which were rather closely accordant with the velocity it should have if at rest with respect to the stars in general; that is, the observed velocity for the calcium seemed to be the component of the solar motion toward the star. In the present instance the observations are quite contradictory to such interpretation.

Dominion Astrophysical Observatory,
Victoria, B.C.
July, 1920.

ORBIT OF THE SPECTROSCOPIC BINARY H.R. 8800

By Reynold K. Young

The star H.R. 8800 (1900 R.A. = 23h 02.7m: Decl. = +45° 33′) was discovered to be a spectroscopic binary by the writer in 1918 from five one-prism plates taken with the 72-inch reflector. These plates indicated that the H and K lines of calcium did not oscillate with the other lines and an orbit was undertaken chiefly on this account. The spectrum is approximately B3 type. All the lines, including H and K, are rather diffuse and wide though the latter lines are better than the others. The spectrum is very similar to that of H.R. 8427 whose orbit has just recently been finished.

The orbit is based on 27 single-prism plates listed in the table of observations. These plates are taken in three years and hence it was necessary to include the period in the least squares solution. The approximate period was selected as 3.337 days. With the aid of this period the observations were grouped into 16 normal places as given below. This procedure is not theoretically sound, as the observations which go to make up a normal have different values for the differential coefficient determining the period, but practically, if a normal place includes only a few revolutions, the solution is almost as rigid as if each place is treated separately and the labour is greatly reduced.

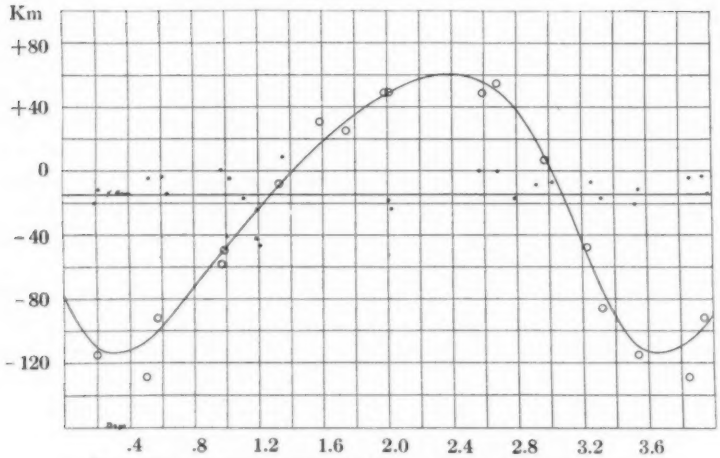
The details of the solution will appear in the Publications of the Dominion Astrophysical Observatory and only the observations and the final elements are published here, together with the radial velocity curve drawn from them.

P = period	= 3.3372 days	±	.00023
e = eccentricity	= .2326	±	.022
ω = longitude of periastron	= 125°.67	±	7°.08
K = semi-amplitude	= 87.70 km	±	2.68
T = periastron passage	= J.D. 2,422,151.272	±	.0623
γ = velocity of system	= −15.13 km	±	1.79
V = velocity of Calcium	= − 9.1 km	±	1.39

$a \sin i = 3{,}910{,}000$ km

$$\frac{m_1^3 \sin^3 i}{(m + m_1)^2} = 0.215 \odot$$

Radial Velocity Curve of H. R. 8800



Open circles represent normal places. Small circles represent velocities from H and K lines.

OBSERVATIONS OF H.R. 8800

Plate	Date	Julian Date	Velocity	No. of Lines	Wt	Phase from T	O−C	K Line
370	1918 July 16	2,421,791.968	− 39.9	3	1	1 114	− 6.0	−16.8
421	" 30	1,805.950	+ 25.5	3	1	1.747	− 5.1	
566	Sept. 5	1.842.898	+ 49.2	3	1	1.986	+ 2.0	
885	Nov. 20	1.918.644	− 57.9	6	1	0.976	− 6.9	+ 0.4
1129	Dec. 23	1.951.567	−128.6	3	½	0.527	−24.2	− 4.8
2319	1919 July 8	2,148.957	− 43.8	7	1	1.022	+ 1.2	− 4.5
2333	" 9	2,149.945	+ 40.6	3	1	2.010	− 8.4	−18.0
2360	" 13	2,153.954	+ 68.6	3	1	2.682	+18.2	− 0.1
2395	" 15	2,155.961	− 15.5	5	1	1.352	− 8.7	+ 8.7
2445	" 19	2,159.969	+ 56.8	4	1	2.023	+ 6.8	−23.7
2464	" 20	2,160.966	− 7.2	4	1	3.020	− 6.4	− 6.9
2521	" 23	2,163.963	.....		0	2.679		
2607	Aug. 6	2,177.957	− 85.6	5	1	3.325	−10.1	−16.8
2620	" 7	2,178.924	− 55.2	4	1	0.954	− 2.2	
2655	" 10	2,181.911	− 82.6	6	1	0.604	+13.4	−14.2
2696	" 14	2,185.955	− 0.5	4	1	1.311	+10.7	
2753	" 19	2,190.772	+ 45.8	5	1	2.791	+ 5.8	−17.1
2763	" 19	2,190.903	+ 14.0	6	1	2.922	− 5.6	− 8.5
2767	" 19	2,190.969	+ 14.6	3	1	2.988	+ 8.6	
2782	" 20	2.191.919	− 96.1	3	1	0.601	+ 0.7	− 3.7
2778	" 20	2,191.822	− 97.1	3	1	0.504	+ 8.9	
2793	" 21	2,192.902	+ 31.3	1	½	1.584	+14.6	
2810	" 22	2,193.890	+ 50.4	3	1	2.572	− 4.7	+ 0.4
4631	1920 July 14	2.520.954	+ 49.0	7	1	2.590	− 7.8	
4650	" 18	2.524.963	− 58.7	4	1	3.262	+ 1.3	− 6.7
4702	" 25	2.531.906	−114.1	5	1	0.193	− 2.4	−20.7
4703	" 25	2.531.927	−115.5	6	1	0.214	− 5.5	−11.8
4728	" 27	2.533.908	.....		0	2.195		
4739	" 28	2.534.932	− 24.8	3	½	3.219	+24.2	

DOMINION ASTROPHYSICAL OBSERVATORY,
Victoria, B.C., Aug. 26th, 1920.

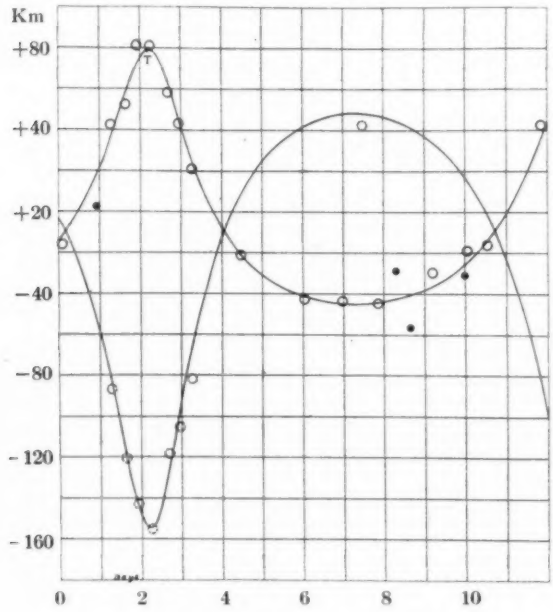
ORBIT OF THE SPECTROSCOPIC BINARY H.R. 6169

By Reynold K. Young

H.R. 6169 (R.A. 1900, 16h 30.9m; Decl., +17° 15′) was announced as a binary in 1919 by the writer from four single-prism plates. These spectra showed a range of about 60 kilometers and the lines looked fairly sharp. Thirty-eight additional observations have been secured with a view to determining the orbital elements. On many of the later plates the secondary component is plainly visible though very much fainter than the primary. The ratio of intensities being about 3 to 1. When the lines are superimposed, the spectrum shows a fairly good A0 type spectrum, many of the iron lines, such as 4045, 4063, 4071 and other metallic lines being visible. At other times only the calcium line and the hydrogen series and magnesium 4481 could be measured. The magnesium line in the component spectrum seems to be weaker than the other lines, for under all circumstances this line is fairly sharp.

The period was soon found to be approximately $10\frac{1}{2}$ days and when the observations are plotted on a single revolution they show that the orbit is quite eccentric and that the observations of the two components are clearly resolved only on one half of the orbit. The great difference in intensity of the two components makes the measures of the blend follow the orbit of the primary. In the solution for the elements all those observations which showed single lines were assigned to the primary curve and given smaller weight than those observations where the two spectra could be measured. Two plates taken near the crossing point but blended so as to make the lines diffuse were rejected entirely. The measures of the secondary were also included in the solution and given weights as indicated in the table of observations below. The columns are in order, the plate number, the date of observation and the Julian Day, the velocities obtained for components one and two, the number of lines measured and the weights assigned, the phase of the observation, using the final period, and finally the residuals which the final elements give for the observation. These were determined graphically.

The early observations are very poorly situated for determining the period accurately. They are shown as solid circles on the radial velocity curve given herewith, and it can be seen that the last three have scarcely any weight while the first is near a crossing point. This observation has to be brought forward sixty-one revolutions. The observations in 1920 cover ten revolutions. If we shift the early observation forward to the other crossing point some of the later observations would be shifted backward nearly half a day and this is not permissible. Hence the early observation is assigned to its correct place and, poorly situated as it is, it has more weight in determining the period than the observations in 1920. After allowing for the probable effect of blending, the period was fixed at 10.56 days and not included in the least squares solution, the final results of which are given below.



Radial Velocity Curve of Boss 6169

Period	P	= 10.56 days	±.005 estimated
Eccentricity	e	= 0.430	±.012
Longitude of periastron	ω_1	= 4°.12	± 2°.66
" " "	ω_2	= 184°.12	± 2°.66
Semi-amplitude	K_1	= 62.41 km	± 1.08 km
" "	K_2	= 101.36 km	± 1.64 km
Velocity of system	γ	= − 9.88 km	± 0.85 km
Periastron passage	T	= J.D. 2,422,422.236	±0.046 dys.

$a_1 \sin i$ = 8,180,000 km $\quad m_1 \sin^3 i$ = 2.19 ⊙

$a_2 \sin i$ = 13,280,000 km $\quad m_2 \sin^3 i$ = 1.35 ⊙

$$\frac{m_2^3 \sin^3 i}{(m_1 + m_2)^2} = 0.196 \odot$$

These elements give residuals as indicated in the last column in the table of observations. The probable error of a plate of average weight is ±2.9 km. for the primary and ±4.3 km. for the secondary.

OBSERVATIONS OF BOSS 6169

Plate	Date	Julian Date	Velocity Comp. I	Velocity CompII.	Lines	Wts.	Phase from 2,422,420	Residuals O−C
285	1918 July 1	2.421.776.753	+ 2.1		4		0.91	−15.0
1848	1919 Apr. 21	2,070.936	−31.2		6		9.98	+ 5.6
2062	June 1	2.111.836	−56.6		4		8.64	−15.8
2343	July 13	2,153.732	−28.8		4		8.29	+14.0
4012	1920 Apr. 5	2,420.906	− 6.6		4	0	0.906	−23.6
4030	" 7	2,422.934	+47.5	−110.1	3-2	2-1	2.934	+ 1.5 −12
4050	" 9	2,424.877	−20.6		6	2	4.877	+ 8.8
4069	" 10	2,425.970	−48.2		4	3	5.970	− 3.2
4079	" 12	2,427.863	−45.2		2	2	7.863	− 1.2
4091	" 13	2,428.963	−35.3		1	1	8.963	+ 2.9
4145	" 23	2,438.905	−25.5	+ 51.1	7-1	3-0	8.345	+16.5 + 7
4157	" 24	2,439.953	−28.3		2	2	9.393	+ 6.0
4169	" 25	2,440.924	−19.0		7	3	10.362	− 0.4
4188	" 30	2,445.887	−17.4		4	2	4.767	+ 9.6
4196	May 1	2,446.925	−15.1		3	0	5.805	+24.9
4208	" 2	2,447.906	−54.3	+ 44.8	2-1	2-1	6.786	− 9.5 − 2
4218	" 3	2,448.841	−45.4	+ 52	4-1	4-1	7.721	− 0.8 + 5
4244	" 5	2,450.852	−19.2		8	3	9.732	+10.8
4279	" 12	2,457.878	−34.6		3	2	6.198	+ 8.1
4289	" 13	2,458.834	−33.4		2	2	7.154	+11.8
4304	" 15	2,460.813	−28.6		6	2	9.133	+ 8.4
4314	" 19	2,464.817	+63.8	−127.4	6-4	4-2	2.577	− 4.6 + 9
4331	" 21	2,466.822	−26.8		9	3	4.582	−3.0
4343	" 24	2,469.758	−57.1	+ 33.2	4-1	3-1	7.518	−12.1 −15
4354	" 27	2,472.848			5	2	0.048	− 4.5
4356	" 30	2,475.760	+41.2	−103.0	7-5	4-2	2.960	− 3.6 − 8
4368	" 31	2,476.779	−19.0		12	3	3.979	−11.0
4393	June 2	2,478.840	−44.3		1	1	6.040	− 2.3
4404	" 11	2,487.814	−23.3		11	2	4.454	− 3.0
4419	" 17	2,493.795	−14.9		5	2	10.435	+ 2.0
4428	" 18	2,494.778	−12.9		5	0	0.858	−27.9
4435	" 19	2,495.843	+81.3	−143.4	5-3	4-2	1.923	+ 9.3 + 2
4441	" 20	2,496.721	+52.2	−109.3	4-3	4-2	2.801	− 2.8 + 5
4459	" 25	2,501.780	−53.6	+ 39.8	2-1	2-1	7.860	− 9.6 − 7
4480	" 28	2,504.748	−16.4		9	3	0.268	− 9.6
4498	" 29	2,505.758	+42.3	− 87.5	6-4	4-2	1.278	+ 5.5 − 2
4506	" 30	2,506.715	+73.7	−140.5	3-2	3-2	2.235	− 5.3 +15
4508	" 30	2,506.751	+87.0	−161.3	7-7	4-2	2.271	− 8.0 − 6
4511	" 30	2,506.814	+80.2	−169.2	7-6	4-2	2.334	+ 2.6 −17
4523	July 1	2.507.734	+20.7	− 82.5	5-3	4-2	3.254	− 4.3 −16
4656	" 21	2,527.767	+78.1	−151.6	6-5	4-2	2.167	− 0.9 + 3
4740	" 31	2,537.787	+52.2	−120.5	8-7	4-2	1.627	− 5.7 + 2

DOMINION ASTRONOMICAL OBSERVATORY,
Sept. 1920.

THE ORBIT OF THE SPECTROSCOPIC BINARY BOSS 5900

By W. E. Harper

This star (1900, R.A.=22h 48.2m; Decl.=+16° 19′, visual magnitude, 5.72; type K0) was found to be a spectroscopic binary by the writer from the second plate made in the autumn of 1919. Ten plates were secured at that time and seven more have been added this summer, making seventeen observations upon which the determination of the orbit rests. They are all measured on the Hartmann comparator, a spectrum of the star Arcturus (No. 2702) serving as the standard. The data of the plates follow.

OBSERVATIONS OF BOSS 5900

Plate Number	Date	Julian Date	Phase	Velocity	Residual O−C
2915	1919 Sept. 9	2,422,211.845	5.50	+20.6	+ 0.6
2972	" 15	217.786	11.44	− 7.2	− 1.8
3109	Oct. 3	235.762	4 .77	+19.5	+ 1.2
3172	" 13	245.766	14.77	−34.0	− 1.8
3203	" 18	250.716	19.72	−47.2	− 2.9
3220	" 24	256.713	1.07	− 7.4	− 3.6
3306	Dec. 1	294.617	14.32	−27.6	+ 1.4
3381	" 5	298.566	18.27	−42.4	+ 3.6
3392	" 7	300.561	20.27	−43.3	− 0.7
3406	" 8	301.546	21.25	−36.8	+ 1.3
4322	1920 May 19	464.973	12.13	−12.0	− 0.8
4377	" 31	476.966	24.12	+18.9	− 1.7
4472	June 25	501.960	24.47	−14.0	+ 0.3
4494	" 28	504.971	2.83	+ 9.2	+ 0.1
4545	July 2	508.957	6.82	21.4	+ 1.5
4578	" 5	511.953	9.81	+ 7.1	+ 0.1
4649	" 18	2,422,524.933	22.79	−25.5	+ 2.4

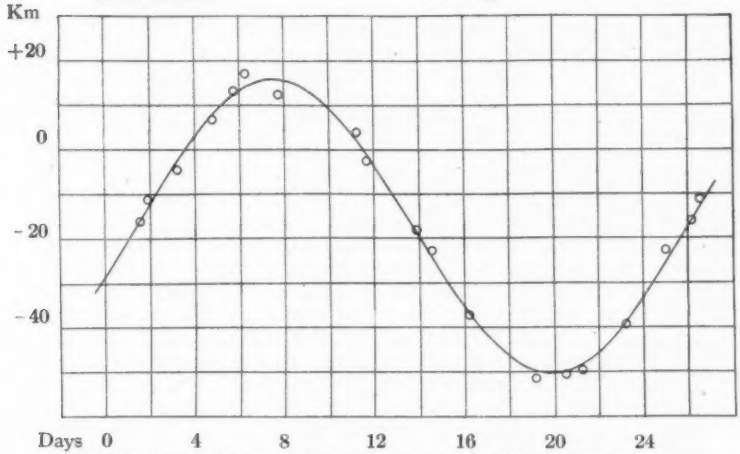
The period deduced from connecting up the observations of the two seasons was 24.65 days and this element was not considered in the least squares-solution. A plot according to this value showed the observations to follow a sine curve so closely that it was decided to consider the orbit circular and solve only for the velocity of the system, the semi-amplitude, and an initial epoch, here taken as the time when the orbital velocity is passing from negative through zero to positive values. In this case the formulae are much simplified and the least-squares sulution for the three elements mentioned gave the following values.

The solution reduced the sum of the squares of the residuals very slightly—from 59.7 to 58.4—but as the differences between equation and ephemeris residuals are less than 0.1 km. no second

solution need be considered, and the preliminary elements adopted were, therefore, very close to the truth. The probable error of a plate is ±1.26 km. per sec.

FINAL ELEMENTS

Period	24.65 days
Eccentricity	0
Velocity of system	−12.84 km± 0.34 km
Semi-ampilude	33.20 km ± 0.49 km
Perihelion passage	J.D. 2,422,240.992 ± 0.054 days
Projection semi-major axis	11,254,000 km
Mass function	.004 ⊙



Radial Velocity Curve of Bôss 5900 showing individual Observations

The graph shows the individual observations plotted on a sine curve. It has been noted by others and attention may again be directed to the low values of the eccentricity found in several stars of G- and K-types, and exemplified in the case before us. It would seem that the early idea of the eccentricity being a function of the type should be modified, as its variation with the period within the type is as marked as the variation from type to type.

DOMINION ASTROPHYSICAL OBSERVATORY,

VICTORIA, B.C.

July 23d, 1920.

THE FESTIVAL OF THE DEAD

By R. G. Haliburton

(*Continued from page 427, December issue*)

What was the meaning then of this emblem? We find the T surmounted by a circle, and the scarab represented with expanded wings. It is plain that there must have been some reference to the divisions of the year. The Pleiades were known as *Atoria*, or *Atauria*. Is there any connection between the year of the Pleiades and a *Tau*? The symbol would seem to indicate *three* divisions or seasons (possibly, though not probably, two). The Egyptians had divisions of the year into two, three and four seasons respectively. Let us go south of the equator for a clue to this matter. Among the primitive races of the Pacific Islands, among whom the year of the Pleiades is still to be found, we find a year of the *Tau* or of the two seasons of the Pleiades, and that the year was also divided into three seasons, each of which was a *tau*. Ellis says of one of these divisions they reckon it "by the *Tau* or Matarii season or half year." Matarii is the Polynesian name of the Pleiades, the Stars of *Ataur* of the North, or of *Taurus*.[4] No one would pretend to argue that the Polynesians, the Australians, and the Mexicans derived their knowledge of the year of the Pleiades from the Egyptians. They all inherited it from a common source. Hence as the heavens were not mapped out into the forms of animals by the Polynesians, and the signs of the Zodiac and Bulls were alike unknown to the Pacific Islanders, it is evident that the Polynesian word *tau*, a season, is not only the root of *Ataur*, and *Taurus*, but also of the letter *Tau* in the Egyptian, and of its representative, the letter T in our alphabet.

We may infer that when the year of the *Tau* migrated to the north, or civilization was developed, the present imaginary and conventional forms of constellations were invented, and the stars of the *Tau* were placed in the neck of the Bull, an animal not a native of the Pacific Islands. This constellation still bore the name of the Tau. It was called *Ataur* and Athyr, from which it is not improbable we have the Latin *Taurus*, and the German *Thier*. The year of the *Tau*, and the stars of *Ataur* have left their impress on the very mountains of Great Britain.

The reason has not been explained why the Greek word Bounos, as well as Bomos, meant a hill and an altar—both being derived from a word signifying a *Bous* or an ox. Why is many a hill still known in England as a *Tor*, and others designated as *Arthur's Seat*—a name also applied to some hills in Germany?[5] There can be but little doubt that our ancestors raised their "seven altars" on these hills to the stars of the *Tau*, or of Athyr; and that

[4] See Ellis' Pol. Res., i. 186. Ellis is not very precise as to their seasons and has confounded the first with the second season of the Pleiades.

[5] See Volmer v. *Arthur*. It is worthy of note that *Hu* (the Bull or Arthur, in Britain) meant in Egypt "a hill." See Bunsen's Egypt, i. 465.

to this day the memory of "the pleasant influence of the Pleiades,' commemorated by Job, and celebrated by Australian savages, is still lingering in Britain under the popular traditions as to "*the good King Arthur.*"[6]

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[6] I have called the scarabæus the hieroglyphic for the letter T. The marks on its back, which probably suggest the precise sound it represented, not having been noticed, its name and the letters signified have been supposed to be *ta* (Bunsen's Egypt, i. 582), and Gliddon gives the name *Thore* to it, and supposes that it represented *Th*. But if the latter is pronounced like *th* in the German *Thor*, the sound and the name given by both authorities are really the same, viz., *tor* or *tau*.

The various modes of spelling the name of Athor suggests this meaning, and also the sound for the *th*, which if thus pronounced like *t*, shews that the various forms that the astronomical deity Ataur assumed in Egypt, Britain and Syria were in reality the same, viz.: Ataur, Athor, Athyr in Egypt; Arthur and Artus in Northern Europe (see Volmer v. *Arthur*. Hawks' Egypt and the Bible, 56), and Atys in Syria. The Greek mode of spelling Athyr would, however, indicate that both of the pronunciations suggested may have been in use. I was unable before the preceding page went to press to obtain from J. M. Jones, Esq., F.L.S., the author of "the Naturalist in Bermuda," who is referred to in the preceding page, the precise mode of spelling the name for the scarabæus in England. I had therefore only the sound of the name to guide me. The coincidence between the name of our beetle, and that of the Egyptian scarab was so remarkable, that I could scarcely bring myself to believe that ours was not a modern name suggested by the resemblance in our Dor beetle to the Greek tau. But it is evident from a reply to my enquiries on this point which I have since received from Mr. Jones, that "Dor" (tor?) is an old English name which must have come to us from remote antiquity and from a time when a fancied resemblance to the T or *tau* in the Greek or any other alphbet could never have suggested the name. Whatever caused our hills to be known as *tors*, must have also given the same name to the *Dor* beetle of Britain, and to the T beetle of Egypt; and the symbol must have supplied the letter T to the alphabet.

Whatever the origin of the symbol can have been, it must have been intimately connected with some very marked religious ideas of primitive man. The scarabæus (or *tau*) was the most sacred emblem of the Egyptians. We find the deity represented sometimes as a scarab with a human head, sometimes as a *Triad* with the symbol of the tau. Sir Gardner Wilkinson, speaking of the representations of the king being received into the society of gods, says: "Sometimes Thoth, with other deities taking him by the hand, led him into the presence of *the Great Triad* or of the presiding divinity of the temple. He was welcomed with suitable expressions of approbation, and on this, as on other occasions, the sacred *tau*, or *sign of life*, was presented to him, a symbol which, with the sceptre of purity, was *usually placed in the hands of the gods*. These two were deemed *the greatest gifts bestowed by deity on man*. The origin of the Tau I cannot precisely determine; but this curious fact is connected with it in later times, that the early Christians of Egypt adopted it in lieu of the cross, which was afterwards substituted for it, prefixing it to inscriptions in the same manner as the cross of later times; and numerous inscriptions headed by the *tau* are preserved to the present day in the Great Oasis." (Manners and Customs of the Ancient Egyptians, i. 277.)

The proofs that I am correct on this point are too numerous to be all adduced here; but I shall select two of our modern customs—the use of the *hot cross bun,* and of Easter or paschal eggs. Among the ancients there was a sacred cake which was called *Bous,* or *Boun,* or the cake of the bull. We find it on Egyptian monuments with a cross similar to that on our hot cross buns, and evidently typifying the four seasons of the year of Taurus,

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* Mr. Jones says: "A very common beetle (*scarabaeus stercorarius*) is known in many parts of England *to all classes* under the name of *'Dor'* or *'Dorr.'* Why or wherefore, I believe, is not known; at least we may judge so from the fact that no satisfactory conclusion has yet been arrived at in that respect, although various reasons have been assigned by naturalists to endeavor to account for such an appellation. Your suggestion as to the antiquity of the name, and to its relation to the perfect *tau cross* formed by the sutures on the back of the species comprised under the genus scarabæus, to which the sacred beetle of Egypt belongs, appears to me very strong evidence of the name 'Dor' (doubtless a corruption of *tau,* or *tor* as the cross of that form is frequently spelt in works on ecclesiastical architecture) having thus originated.

"I send you a sketch of the sutures on the back of the English *Dor* beetle, taken from a specimen in my collection. Are you aware that carvings of scarabæi have been found on royal sepulchres of a prior date to those of the Pyramids?"

I think it will be found that the perfect cross and the *tau* cross represented respectively the divisions of the year into four, and into three seasons, or *taus,* and that they were connected with the seasons of the Pleiades. M. Layard has already conjectured that the *crux ansata* or the *tau* symbol was the same as the Assyrian emblem of the winged figure in a circle, and though his ideas on the subject have not been accepted as correct, there seems but little doubt that they are very near the truth. (Layard's Nineveh and its Remains, ii. 213; also ii. 446.)

I would draw attention to some symbols given by Layard in his Nineveh and its Remains, in which we have enclosed in rings or circles the seven Pleiades and the cross. The Egyptian Apis and the winged Bull of Assyria, both plainly types of *Taurus,* are sometimes represented with the cross or tau suspended from their necks. The sacred cake marked with a cross, and our *hot cross bun,* are really the same as the bous (the cake with the head and horns of Taurus stamped on it) and the cake placed by our peasantry on the horns of an ox; and Taurus and the cross or the tau must be connected with each other, in the same manner as "the *year of the Tau* or *of the Matarii*" (the Pleiades) in Polynesia at the present day. But the connection of Taurus and the Pleiades with the sacred Tau is proved by the fact that Thor (see ante, p. 82) is the Phoenician word for a *Bull;* and that on Babylonian cylinders and monuments, the Seven Stars are frequently placed near the emblem of the Tau. In one instance their "pleasant influence" is typified by the *Three Graces* (or seasons?), who, standing on the head of Taurus, are followed by these stars. (Landseer's Sabæan Researches, 116, 263, 283; also Lect. ix. See Horace Odes, i. 4. Plutarch, Quaesi Grate, p. 299.)

The Egyptian divinity ("the sacred *Triad*"), who has the tau as a symbol, was, as we have seen, the representative of the year and of its seasons; and by its *triune* character, as well as by its emblem, must have represented the three seasons of the *Tau* or of the Pleiades. Our popular

as the headless cross or T did that of the three seasons of the Pleiades. On some of these sacred cakes the head and horns of a bull were stamped. The one has its representative in our hot *cross bun,* as has been already discovered by Bryant.[7] But the other is also not forgotten by our peasantry. It is a custom among the Scotch to leave cakes at their neighbors' doors[8] on new year's

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superstition as to the shamrock or trefoil are probably derived from the same source as the heathen *triads* which have so puzzled all enquirers. It would be an interesting confirmation of these conjectures if we could prove that the ancient Britons had a year like that of the Egyptians, of *three* seasons.

But we find that *tar* (tau?) (Bunsen's Egypt, i. 537) was the Egyptian word for *time,* and hence the deity and *time* must have been the same. Champollion discovered that "a *hatchet* named *tar* (tor?) is one of the commonest symbols of 'God or Divine Being,' because that idea *was denoted by the same sound ter.*" (Hawks' Egypt and the Bible, 64.) But here we have the Scandinavian *Thor,* and his hammer or stone axe. These facts explain what has long attracted my attention. Human beings were in Mexico, India, Egypt and Scandinavia, as well as in other parts of the world, offered to *time* (Saturn, Cali, Osiris, and Thor) at the end of the year, or of a cycle. In p. 23, I have referred to the Mexican sacrifice which was made with an axe of obsidian. The Sacred Books of India not only enjoin the same rites, and prescribe that human beings are to be offered on a mountain (tor?) or in a cemetery to Cali (i.e., *time*), but also that the implement used must be a *flint axe.* (See Maurice's Ind. Antiq., vii. 645, 857.) The axe is frequently the emblem of a god or a priest. Human beings were offered by northern nations to Thor (Mallet's Northern Antiq., 116), who plainly was the god of Time and of the sidereal year of the *Tau.* (See Volmer v. *Thor.*) His palace had 540 halls (i.e., years), which are simply a period, similar in principle to the periods of the Hindoos, which make up 25,920 years (48 x 540 equals 25,920 years)—the time in which northern nations must have supposed that a complete revolution of the sidereal around the tropical years is accomplished, it being only 80 years in excess of the Hindoo calculation, and 180 years more than the true period. (See ante, p. 89. Also Pigott's Manual of Scandinavian Mythology, p. 35.)

In confirmation of my conjecture as to the year of the Pleiades having existed among the northern nations of Europe, and of the mother night having been transferred from Halloweve to Yule, I find that the first "celestial residence" or month began on November 22nd. February 19, April 21 and August 23rd were days on which different months began, which is a coincidence with the days I have selected as connected with the divisions of the primitive year, that may be accidental, but is at least worthy of notice.

[7] See Brand's Pop. Antiq., i. 155. Bryant's Mythology, ii. 422.

[8] This custom has found its way to the colonies. I was much puzzled on two occasions by getting this peculiar new year's gift. The custom of making presents as well as visits to neighbors on new year's day is found to exist in most countries, these gifts consisting sometimes of eggs and other edibles. But not only friends were thought of, but also the souls of departed relatives. It was customary among ancient nations on the "mother night" to make offering to the spirits. Among the Russians, Took says, in his View of the Russian Empire, ii. 66, "at the New Year a feast of the

eve, on which night the "Candlemas Bull" can be seen, as we are told, rising at twilight and sailing over the heavens. But in Herefordshire it was recently the custom not to forget the living representatives of Taurus. On Twelfth Night it is customary to prepare a large cake, perforated with a hole in the centre, which is placed on the horns of an ox.[9] Hence we must admit that it has a fair claim to the designation of a *Boun*, or a cake of Taurus.

What is the reason that at Easter European nations have the custom of making presents of eggs, which are frequently dyed red and are called paschal eggs? As the new year's festival of our ancestors in honor of Taurus resolves itself into the great annual corroboree of the Pleiades of the Australians, so the origin of our Easter eggs must be sought for in the rude traditions of the creation preserved among the Australian savages.

Easter eggs are used among Asiatic nations at the beginning of the year; and among the Persians at the time of the vernal equinox. Gebelin[10] informs us "that the custom of giving eggs at Easter is to be traced up to the theology and philosophy of the Egyptians, Persians, Gauls, Greeks, Romans, etc., among whom an egg was the emblem of the universe, the work of the Supreme Divinity." In Egypt the Deity was represented by an egg.[11] Hutchinson[12] in his History of Northumberland, ii. 10, says "eggs were held by the Egyptians as a sacred emblem *of the renovation of mankind after the deluge.*" The Jews, who use eggs at the passover, have a tradition that they do so in honor of a mythical bird called Ziz. We must look for the origin of the custom in the religious ideas of primeval antiquity. Let us turn to the Australians for a clue to the mystery. In the interesting report on the

dead (*Raditeli Sabol*)" is annually held, in which everybody visits the grave of his relations, laying some victuals upon it, and hears mass, in payment for which the priest gets the victuals." In Yucatan on "All Souls," food is offered to the spirits and mass said on their behalf; and "soul cakes" are still a feature of our "All Souls." An old English writer in 1493, speaks of "Alle that take hede to dysmal dayes, or use nyce observaunces *in the new moon*, or in the new yere, as setting of mete or drynke by night on the benche, to fede *'Alholde or Gobelyn'*" (Brand's Popular Antiq., i. 9). The custom arose from the year commencing with the festival of the dead. In India these soul cakes are offered in the early part of October, at the festival of the dead.

[9] Brand's Pop. Antiq., i. 30. So singularly was the deluge by almost all nations mixed up with the year, and with Taurus, that we are told by a Greek writer that the "sacred *heifer* of the Syrians is no other than Theba, the *ark*." "The ark among the Syrians is styled *Bous* (or cow)." See Bryant, ii. 422.

[10] iv. 251. See Brand's Pop. Antiq., i. 168.

[11] See Bunsen's Egypt, 368.

[12] Gebelin says that the *cow* was the emblem of darkness or chaos, and the *Emeph*, or egg God, the symbol of creation or light.

Aborigines of Australia, published in the Journals of the Legislative Council of Victoria for 1858,[13] we find that Mr. Beveridge says: "In the traditions of natives respecting the creation they say:—*at one time they were all birds and beasts,* and there was no sun, *but darkness dwelt upon the land*: but in a dispute between the *Emu* and a native companion, *the latter threw an egg of the former up to the sky, when it broke and became the sun, and the world was flooded with light, and thousands of birds became men.*"

Here we have a clue to one of the most singular features in ancient symbolism and mythology, "the mundane egg" as it is called—or the egg of creation, and to the origin of our Easter custom, which is simply a commemoration of "the *Emu's egg.*" This explains the Hindoo belief that Brahma was born of an egg;[14] and the Egyptian myth that *Ra* (or the *Sun*) and other gods, *sprang from an egg.* The connection is the more striking when we remember that *Ra* is the Polynesian name for the *Sun.*[15]

The Greeks not only seem to have held that birds were created before men, but also that creation itself sprang from an egg.

"First was Chaos and Night, and black Erebus and vast Tartarus;
And there was neither Earth, nor Air, nor Heaven; but in the boundless bosoms of Erebus,
Night with her black wings, first *produced an aerial egg,*
From which at the completed time, sprang forth the lovely Eros,
Glittering with golden wings upon his back, like the swift whirlwinds,
But embracing the dark winged Chaos in the vast Tartarus,
He *begot our race* (the birds), *and first brought us to light.*
The race of the Immortals was not, till Eros mingled all things together;
But when the elements were mixed one with another, Heaven was produced, and Ocean,
And Earth, and the imperishable race of all the blessed Gods."[16]

This passage from Aristophanes, giving priority to birds in the creation, may be supposed to be inserted because his *dramatis personae* are birds. But it is plain this is not the case, as we find almost everywhere the traces of the bird as well as of the egg of creation, deluge, or time. The same idea as to the egg exists in

[13] P. 69.

[14] See Maurice's Ind. Antiq., iii. 457, 458; vii. 846. Dubois' Manners and Customs of the Hindoos, 371.

[15] Bunsen's Egypt, i. 367, 368, 377, 384, 385, 423.

[16] See Aristop. Aves., 698; Suid. v. Chaos. Cory's Fragments, 294.

the poems attributed to Orpheus. In the Orphic hymn[17] to Protogonus (*i. e.* the first *created*) he is thus addressed:

"I invoke Protogonus of a double nature,
Great, wandering through the ether,
Egg born, rejoicing in thy golden wings;
Having the *countenance of a bull*, the procreator of blessed gods, and of men." [18]

A large volume might be written on the subject of traditions as to the mundane egg, which is frequently connected with the Bull or Taurus. Gebelin, Faber, Bryant, De Rougemont, Davies, and a host of other writers, have gone fully into the subject, and a reference to their works will supply the reader with the proof of the singular universality of the emblem of the egg, and of its connection with the creation and with the deluge, as well as with time and with the year, all of which were mixed up and confounded in a singular manner in the mythology of the ancients. But as the Pleiades were also associated with the year, they in many instances became the representatives of our *ancestral Emu* (*!*) that bird of time, of the creation, and of the deluge, and appear as Peleiades or doves, as Pillalou codi (the hen and her chickens[19]), as *Samen* or *Ganesa*, the swan or goose, as *Manu*, or the fowl, and as the more illustrious *Phoenix*.

It would take me too long in this preliminary paper to trace all the forms in which the *Emu* and its egg appear in connection with the Pleiades. Semiramis was born of an egg, which came from the waters of the deluge, and was brooded over by a Peliad or dove.[20]

Castor and Pollux sprang from an egg, and alternately for six months resided in Hades, and then rose to light, which is simply the Pleiades above and the Pleiades below, mixed up with the story of the *Emu's* egg.

But let us see how this myth appears in connection with those festivals of which I have been treating, and which, regulated apparently by the Pleiades, were connected with time, the year, and the deluge. We have seen that in Central Africa the *hen* and *the palm tree* are the principal features in the history of the deluge. Now the Phœnix means both a bird and a palm tree—and both are symbols of time, the one is the emblem of a cycle called the Phœnix period, and the other the hieroglyphic for a *year*.

[17] Id., 293.
[18] See Mystical Hymns of Orpheus, trans. by T. Taylor, 18.
[19] See ante, p. 16.
[20] Numerous illustrations of these myths are given by Gebelin, Le Monde Primitif, iv. 256.

In Egypt the deluge was commemorated at the same time as in Mexico, "when the Pleiades were most distinct," when also the corroboree of the Pleiades is now held by the Australian savages. Typhon or Baba, the god of the deluge, is represented by a swan or goose, called *Samen* by the Egyptians. At the Isia, on the 17th of Athyr, not only was the emblem of the cycle of Taurus, the *Bull Apis*, led in procession, but also the *Bird* of time or of the deluge, the goose of Set or Typhon. In Rome the sacred goose was also conspicuous in an annual procession, which probably will be found to have occurred on the 17th of February, or towards the end of August, as the commemoration of the year and of the deluge seems to have generally occurred among ancient nations at the time of one of the three most remarkable culminations of the Pleiades, *i. e.* at midnight, sunset, or sunrise, November 17th, February 17, and August 21st or 22nd.

But the goose of Typhon was called *Samen*, and Sanchoniatho says the first god worshipped by men was Beelsamin.

In Ceylon we find there is a sacred goose called *Angsa*. There is a great festival at the time of the full moon of August. Previous to its occurring a *bough is cut from the sacred Bo tree*, which is carried in procession at this commemoration of the deluge and of the year. We have at this festival, not only the Hindoo god of the deluge, Vishnu, who is always accompanied by his bird Garuda, but also a native Cinghalese god *Nata-samen*. As the god Bali or Bel is also worshipped by the Cinghalese, it is probable that we have in Nata-samen the Beelsamen mentioned in the scriptures and by Sanchoniatho; and it is not improbable that on enquiry we shall find *Samen* or *Angsa*, the goose, appearing in the procession as it did in Egypt.

In Hindostan the deluge is commemorated on the 22nd of August for three days, and occurs at the time of the culmination of the Pleiades at sunrise, and at the time when the dove left the ark in our history of that event. We have Ganesa, Manu, and the *seven* holy Rishi's commemorated. Now in some of the dialects of the natives of the Indian Archipelago, which belong to the same family of languages as the Polynesian, we find that gangsa and angsa mean a *goose*, like the German ganz, or ganze, and the Latin anser, and *Manu* means a *fowl* or bird. The representations of Ganesa, and the Hindoo mode of pronouncing his name, though they do not confirm this view, do not prove this coincidence accidental. The circumstance that Brahma (Time) was born of an egg, and that Carticeya appears riding on a peacock, confirms the view that the brother of Carticeya may have been the representative of *Samen* or *Gangsa*. But Ganesa is the Indian Janus, like Carticeya, and is represented as a brother of that god of the

Pleiades,[21] and I have shewn that Manu and the manwantara (the period of Manu) are connected with the progressive year of the Pleiades.

So intimately was the idea of a bull or a bird blended with time, that one of the names by which the Pleiades are known in the Indian Archipelago, *Bintang,* means not only a star, but also a cow or beast (*binatang*), and sapi (apis and ser-apis of the Egyptians?) means a cow. Even the name *paschal* eggs may mean simply "the eggs of *the bird.*" The word paschal, it is well known, is borrowed from the Indian *paksha,* a division of time, and pakshi means in the Indian Archipelago a *fowl.*[22]

But let us turn to ancient Britain to see in which form the bird of time appears. It is most remarkable that our ancestors seem to have had the same tradition as that now existing in Central Africa. We find that Ceridwen, the goddess of the deluge, is represented as the *Hen* of the deluge. Her emblems were an *egg,* and *the branch of a tree.* In Britain the deluge was commemorated and the *cow* was sacrificed on the eve of May Day, *i. e.* of the disappearance of the stars of Taurus in the evening.[23]

When we thus find that everywhere not only by symbols of the *Bird* and of the *Bull* of time or of the deluge, and by the *Bough,* the emblem of the year, but also by the very days when the deluge was commemorated among the Mexicans, the Egyptians, the Hindoos, the Athenians, and our heathen ancestors, the memory of that event was connected with the year of the Pleiades, we can scarcely avoid the inference, that when the Syrians called the ark Bous or the Bull, they were merely expressing openly what other nations did by symbols and by myths, the year of Taurus or the Pleiades.

In alluding to the light which I believe these investigations into the times of observance of the festivals of nations, are likely to throw on the subject of the deluge, I do so with a good deal of hesitation, first, because this event being connected with sacred history should be inquired into with all due reverence, and secondly, because it is a matter which a large number of earnest and good men believe should be taken out of the range of investigation, and placed beyond the pale of scientific enquiry. Yet it must be allowed that the history of the deluge has often proved the stumbling block of science, and the apology of the sceptic. I feel but little sympathy with that want of faith, which forgetting that Christianity owes, not only its existence, but also its protection to the Deity, often seeks to defend revelation by attempting to pre-

[21] Sir William Jones' Works, iii. 326, 353, 363.
[22] See Crawford's Indian Archipelago, ii. 146.
[23] Davies' Myth. of British Druids, 205, 230, 236, 488.

clude all honest and fair investigation, and by exhibiting a bitterness and a want of charity, which seem too often peculiar to theological controversies, and which would not be tolerated in the ordinary affairs of every day life. To rebuke the fears of his followers, the great Head of the Church walked in safety over the waves; and we may be sure that the truth of Christianity will never founder, whatever may be the forebodings of the timid or the unbelieving.

Only the faith of a few narrow-minded bigots is now disturbed by the discovery that the sun does not go round the earth; and before many years the view that the history of the deluge is to some extent at least, of a figurative character, will be accepted as generally, and with as little injury to religion, as the discoveries of astronomers.

When I began to write the foregoing paper the history of the deluge was the last subject I anticipated would be connected with the festivals of nations. But a comparison of the calendars, and the customs of different races, disclosed a fact new to me, but which has not altogether escaped the notice of previous enquirers, that *the ancients connected time with the deluge.* I found that not only was this the case, but also that time and the deluge seemed to have been strangely confounded or at least regarded as synonymous by primitive antiquity; and that the idea of the flood was connected with the beginning, or rather with the end of the year, and of cycles; and that this was not confined to the old world, but also extended to America. I found further that the superstition of nations as to the *seventeenth* day of the month or of the *moon,* was among the Egyptians, the Athenians, and other races, connected with the flood; and that this peculiarity was still more conspicuous in our own history of that event.

Further enquiry revealed a new fact, that the Bull, and the "seven celestial beings," or Taurus and the Pleiades, were from China to ancient Britain connected with that event. I also found it mixed up with a primeval myth as to a *bird,* and a *tree,* which apparently had also a reference to time.

Hence it appears that Sir Wm. Jones was very nearly opening up the same enquiry as I now have, when he drew attention to "the deluge of time" of Asiatic nations,[24] and had he followed out what he suggested as likely to throw a new light on the history of the human race, a comparison of times when the festivals of nations are observed, he would have found that the connection of the deluge with these festivals and with time, was a palpable fact which could not be passed over without comment or enquiry.

[24] See Sir Wm. Jones' Works, iii. 333, 343, 346; iv. 12.

The peculiarity which Greswell, as well as other writers, has noticed in the traditions of the Aztecs, the connection of the midnight culmination of the Pleiades with the deluge and with the end of a cycle, I found even more remarkable than has been supposed, and that the Hebrews, the Egyptians and the Mexicans must have attached the memory of that event to the same day and probably to the same phenomenon. I found Greswell saying, *"we commend this fact to the attention of astronomers.* The fact is certain that the culmination of this particular constellation (the Pleiades) was one of the phenomena presented by the heavens, to which the Aztecs in particular, *for some reason or other, looked* with *peculiar interest* and *attached peculiar importance."* Knowing as I did that the midnight culmination of the Pleiades was connected with a primitive year beginning in November, and hence had nothing whatever to do with the miracle alluded to by Greswell, and that with that month the Hebrews and the Egyptians connected the beginning of the deluge, I felt that I had accidently met with a most marvellous fact, that once established a connection between our account of the deluge and the traditions of heathen nations and of primeval antiquity. It was plain that if the latter were, to some extent, *astronomical* rather than *historical,* our account of it must to a certain degree partake of the same character. At any rate no candid enquirer could meet with a fact like that, and shut his eyes to its importance and significance, or forbear to allude to it, for fear of the odium that the discussion of this subject is apt to entail upon any one who does not accept literally all the incidents and details of the history of the deluge.

The facts referred to in page 63 were entirely unknown, or at least were not thought of by me, when page 23 was written; and my observations in page 103 being the result of subsequent investigations must be to some extent regarded as confirmations of my previous conjectures.

These facts have forced themselves upon my attention. They are so palpable that one could even commence these investigations without having his attention drawn to the connection of the traditions of all nations as to the deluge, with primitive festivals and with the idea of time; and no person could pursue the enquiry without coming to the conclusion that our own history of that event is almost identical with the traditions of primeval antiquity on the subject. I feel convinced that whatever prejudices may be created by the facts I mention, further enquiry will fully substantiate my conclusions; and that the day will come when it will universally be conceded that our narrative of the deluge was neither an historical account, nor an empty fiction; but was a figurative description of that event, that was in accordance with the ideas of primitive antiquity on the subject.

It is not improbable that as the year and the seasons were so intimately blended with the religious ideas of the age in which it was written, and especially with the memory of the flood, the narrative which we now interpret literally was not intended and was not regarded as in every particular an historical account, but partly as a parable or figure as to the year and partly as a record of an event that had stamped its impress on the primitive calendars and festivals of our race.[25]

[25] The difficulty which many persons would feel in conceding that the incidents of the deluge are of a figurative character, is that the introduction of such an allegory would be inconsistent with the inspired character of the word of God. But they should be careful not to create the very difficulty which they wish to avoid. It must be remembered that while the great truths of the Holy Scriptures, which are intended for the guidance and happiness of man, were adapted for all ages and all times, *the form* in which these truths were announced was suited to the age in which the writer lived; and not only was not, but could not possibly be, adapted to all ages, for the tastes and feelings of men are perpetually changing. What is most forcible, and most acceptable to one age, loses much of its effect in the eyes of the next generation, and can scarcely be understood, or at least appreciated, after the lapse of many centuries. I cannot select a more striking instance of this than the use of parallelism and alliterations in the Old and the New Testaments. Longinus, though so great a critic, forgot that he was testing the productions of former ages by the standard of his own times, when he censured several authors for playing upon words or names, and accused them of being guilty of introducing puns which were altogether unsuited to serious compositions, and to the dignity of history. Had his attention been drawn to the same peculiarities in the Bible, he would probably have denounced them as incompatible with the sacred character of a work professing to be written under divine inspiration. I can remember a person having given great offence to many well-meaning and sincere Christians, by alluding to these alliterations. His hearers were horrified by his assertions, and arrived at the conclusion, either that he must be wrong, or that the Bible must be a jest book.

Like too many who discuss the history of the deluge, they assumed their taste and judgment to be an infallible guide, and staked the truth of the Bible on an issue which was unfair to religion, as well as to the person they condemned. They forgot to ask themselves the question, supposing those peculiarities of style to exist, were they not, though inconsistent with our ideas of propriety, the most striking and acceptable form of composition, at the time when the passages in which they occur, were written? Any person who is familiar with the system of alliterative poetry so generally in vogue among ancient nations, can understand how much it must have moulded the tastes of the times in which it was used. That system once in use among our ancestors is to be found in Central Africa. It still exists in India, and appears in the Voluspa of the Scandinavians, and in the productions of our ancient British bards.

The pleasure produced by a contrast, and by a consonance of words, though no longer shared in by us, must have been very great among ancient nations, and must have had its influence on prose compositions and even indirectly on the taste of nations who never adopted this form of poetry. The question, therefore, we should ask ourselves is simply, Was the system adapted to the age in which it was employed?

But while an enquiry into the customs and festivals of nations may tend to throw some doubt on received opinions on the subject of the deluge, it will remove all doubt, I believe, on a point of far more importance to revealed religion, *the unity of origin of our race;* and it was a belief that these researches might assist in establishing that important truth, that first tempted me to incur the labor of collecting these materials for the history of man.

The comparison of the festivals and traditions of nations will, I believe, not only settle this point, but will also lead to an almost equally important result. While we find in the new year's festival of the year of the Pleiades, and its agricultural and funereal characteristics, the key to the origin of pagan idolatry, we at the same time discover how entirely distinct was the religion of the Hebrews from that of other nations. So marked is this diversity that an enquirer into the subject, even if he were a sceptic, on meeting with a race possessing a faith similar to that of the Jews, though he might be ignorant of its just claims to a divine origin, would nevertheless at once conclude that he had before him a peculiar religion, entirely different from all others. He would find its distinctive peculiarities, not only in the grandeur and purity of its conception of the Deity, but also in its being exempted

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In judging of the history of the deluge, we should remember that it was written at a time when the spirit of allegory must have existed to a degree which seems almost incredible to us, and which we can scarcely comprehend. It seems to have been especially applied to everything connected with the year and its seasons, as well as with time and the deluge. I refer to the passage in p. 86 , cited from Greswell, to show how universal must have been this spirit. It is not improbable that the allegories once in vogue among heathen races were understood and received as such for centuries, but in time came to be accepted literally, and to be the foundation of religious systems and beliefs. There can be but little question that our account of the deluge was adapted to the age in which it was written, and that if it was figurative, it was clearly understood as such by the contemporaries of Moses; we may also infer that in consequence of the complete revolution that has since taken place in the tastes and feelings of men, we may be accepting literally a narrative not intended to be so viewed, and thus may have ourselves created a subject of discussion and doubt.

If, even in the time of Chaeremon, the Egyptians retained a knowledge of the astronomical basis of religion, we may be sure that in the time of Moses it was palpable to all classes, not only of the Egyptians, but also of the Hebrews who were resident among them. The latter must have been familiar with the custom of connecting the deluge with the year and its seasons, as the same allegory existed in Syria as well as in Egypt: nor could they possibly have accepted literally the account given by Moses which was so identical with the figurative descriptions of the year and of the deluge with which they had been so long familiar.

Let us therefore be careful how we create a stumbling block which does not really exist, by making the prejudices or the taste of the nineteenth century a test of the truth of revelation.

from any trace of that funereal character that underlies the whole system of paganism from Australia to Egypt, and which led the Greek philosopher to exclaim, "if the beings whom you adore are gods, why do you bewail them? If you mourn for them, why do you regard them as gods?"[26]

The question will naturally suggest itself, whether the Festival of the Dead was not originally a commemoration of the deluge. They were both connected with the beginning of the year, and hence Greswell, who does not seem to know of the existence among almost all races of this festival, and of these traditions, supposes that the Roman commemoration of the dead was instituted in memory of the Flood of Ogyges,[27] which was, like the Feralia, connected with the middle of February in Greece and in Rome.[28] He therefore designates it "the festival of *Fear*," supposing *Feralia* to be derived from our word *fear*. As the Arabs call November, with which traditions as to the deluge were connected by the Egyptians, the Hebrews, and other races, *Rajeh*, ("the month of *Fear*"[29]) Greswell's suggestion does not at first seem so very improbable. But even if that were the meaning of the name, it was not derived from the deluge, but from the unlucky nature of the festival itself, the days of which were nameless and "*stained* by the shadow of death," in the new world as well as in the old.[30] I am inclined to suggest a different origin for the word, viz., that it came from *fero*, to carry the dead in arms, like the name of the festival and of the month in which it was celebrated among the Peruvians, which was Aya-marea — the festival or month of *carrying the dead*. A careful analysis of the mode in which the festival is observed among different races will prove that its origin had nothing whatever to do with the deluge, and that this apparent connection arose from both being associated with time and with the beginning of the year. As a study of the festival itself may somewhat modify the inferences to which the history of the calendar and the traditions of the old world all tend, as to a migration of races from the Southern Hemisphere, it may be as well to enquiry what can have induced all nations to institute this commemoration.

A study of the customs of the American Indians will show its origin, and will prove that the festival was not at first annually observed, and that it was not of a religious, and scarcely of a commemorative character, in its inception. It arose necessarily

[26] See Boulanger, i. 276.
[27] This name reminds us of Oga-ogo (the High God) in Central Africa.
[28] Orig. Kal. Ital., i. 430.
[29] Fasti Cath., ii. 19.
[30] See ante, p. 73.

from interring the dead in the tribal burial place, which was only opened at certain intervals, the form of burial that must have been in vogue in primeval antiquity. Among the Hurons, Iroquois, and other races, at the beginning of every eighth or tenth year, a grand festival was held which was called "Covering the Dead." The bodies of all who had died since the preceding commemoration were exhumed for the purpose of being deposited with those of their deceased kinsmen, which were, during the commemoration of the festival, taken from their resting place and carried back to their former homes. Nations assembled to do honor to the event. Funeral games were celebrated. In every cabin there were rejoicings mingled with mourning, as the living feasted and wept in honor of the dead, and extended their hospitality and their sympathy to their unconscious visitors from the graves. The forest, illumined by bonfires, resounded with the din of mimic combats, and the shouts of victory, which were succeeded at intervals by a sudden silence, only broken by that mournful wail, "the cries of the souls," which mingling with the revelry, told of the funeral character of the celebration.[21]

When the festival had concluded, the bones of the dead were removed from their former homes to the Council lodge, and were afterwards carried from thence to a large trench, which was lined with furs. In this the bones of the deceased, clad in fresh robes, and accompanied by the offerings made to them were laid, to sleep on until the next festival should restore them once more to the cabins and to the hospitalities of their relatives. Bolingbroke, in his "Voyage to Demerary," says that this festival was celebrated in the same manner, and at certain intervals, by all the Indians from Florida to the Orinoco, and he gives a most striking and impressive picture of the touching spectacle which he witnessed at one of these celebrations. He says that he saw the natives carrying those who had died since the preceding festival, in many instances for many miles through the forests, bearing their burdens, which were in all stages of decomposition, during a journey of several days' duration, mindful only of the duty they owed to the deceased to let them rest in the burial place of their tribe with their departed relatives.

In the Relations des Jesuites there is a most interesting account of the festival as observed by the Canadian Indians, agreeing with that given us by Charlevoix and by Bolingbroke.

This form of burial was probably the same which was practised by the race who deposited their dead in the Cave at Aurignac, and though traces of it are to be found in the north-east of

[21] See Charlevoix. Voyage to North America, vol. ii, letter xxvi.

Asia, it seems to have died out everywhere except among some of the primitive races of the new world; and even there nearly all those by whom it was observed have either abandoned their ancient festival, or have been exterminated by the arms of the whites or the vices of civilization.

Among the semi-civilized inhabitants of Peru,[32] we find that the festival of the dead was held *simultaneously* with our All Halloween, All Saints and All Souls. It is also particularly interesting to mark the transition in Peru to the *annual* observance of the festival. The reason of the change is apparent. The causes that gave rise to the celebration no longer existed, and it became a mere commemoration of the dead. Though food was left at the graves, the dead were no longer borne from their resting place to their former homes; but the ancient rites had left their imprss on th calendar of the Peruvians, and stamped it with the history of the festival. The month in which it was held, which, as we have seen, is still called *Aya-marca, "the month of carrying corpses in arms,"* connects our November "All Souls" with the primitive celebration of the wild tribes of America.

The Japanese in their Lanthorn Festival seem to have retained a less distinct memorial of this celebration. Yet still the transition from the primitive custom is very palpable and most interesting. They no longer carry the remains of their relatives from the grave, but they believe that for *three days* in every year *the spirits of deceased relatives return to thir former homes.* The grave yards, as we have seen, are lighted with lanthorns on their All Halloweve, to guide their visitors on their way; on All Saints they are regaled with feasts, and welcomed with festivities; and on All Souls are sent home to the world of spirits in a boat made of straw, which is lighted with tapers to cheer the souls on their dark journey.

We have seen that the Fiji custom of bathing the god of the dead existed among our ancestors, as well as in ancient Greece, India and Ceylon; but I have only recently discovered that it must also have existed in Peru[33] as an annual ceremony. The sacred lake Gualavita represented the Italian Avernus and the Egyptian Lake of Sais. The rush boat of the dead among the Japanese is the rude prototype of the Egyptian Isidis Navigium. But it appears that funereal new year's customs got mixed up with the deluge and even with creation itself. After the flood of Deucalion, he and Pyrrha *threw stones behind them,* which became men and women. This is simply the Hindoo custom after

[32] See ante, p. 21.
[33] See ante, p. 41, 72. See Rivero's Peruvian Antiq., 162, note.

funerals mingled with annual rites observed at the Roman Lemuria.[34]

The continuation of the festival of the dead for *three* days, among almost all nations, even still attested to by the calendars of Christendom, carries us to the Australians, who have also their Halloween, All Saints and All Souls. "They have no sacred days or moveable feasts" except when they make an offering to the dead, "when *after three days* continued dancing, their bodies are cleared *from all appearance of mourning, and there is rejoicing in its stead.*[35]

The Halloween torches, the Feast of Lanthorns, and the festival of the dead, recall to us the Persian belief, that the soul of the deceased before it can take flight to heaven, is compelled to linger on earth for *three days,* during which it is pursued by evil spirits, to drive away which bon-fires are lighted by the sorrowing relatives.[36]

Even the corroboree of the Australians has its counterpart in the languages as well as in the festivals of the north, and with the *cabaree* of the people of Madagascar reminds us of the rites of the *Corybantes,* and the Mysteries of the *Cabiri,* the names of which must have come from the same root, as they were simply festivals of the dead, the one having been instituted in honor of *Baba* (Cybele), and in memory of the appearance and disappearance of *Attis,* and the other being a lamentation for what St. Croix calls *"la mort Cabirique."* [37] It does not seem improbable that the *Corroboree* and *Cabaree* of the South, and the *Corybantes* and *Cabiri* of the North, are indebted for the origin of their names to the Samang word *kabis* or death.[38]

In Polynesia the festival appears in combination with an agricultural celebration, and in some of the Islands is presided over by the god of agriculture and of death. The *Inachi* and the November feast of *Alo Alo* of the Friendly Islands, appear in Greece as the *Inachia* and *Aloa.* Both of these were connected in Greece with the Goddess of Agriculture. Io or Isis (who is the same as Ceres), was the daughter of *Inachus;* and Bacchus and Ceres presided over the *Aloa,* which, like our All Halloweve, was a harvest home,[39] and celebrated in the autumn.

[34] Beans were substituted for stones at this festival of the dead. Ov Fast., Lib. v. 435.

[35] See Report on Aborigines, p. 70, also 63 and 94. See also ante, p. 19.

[36] Hyde, de Rel. Vet. Pers., p. 545.

[37] Mystères du Paganisme, i. 55.

[38] This conjecture is strengthened by our finding that in Madagascar the word *mortê* means death, a fact which shows how extensive is the range of some words. See Crawford's Indian Archipelago, ii. 142.

[39] See Volmer, v. Aloa. Also see ante, p. 20, 29; note to p. 93.

It is to be feared that as All *Halloween* was the festival of "*Alholdes* and Gobelyns," the name has more to do with *Alo Alo*, and the *Aloa*, than with Christianity, especially as rites similar to those of Ceres and Prosperine existed among our ancestors.[40] The Fiji god is not without his representative also in ancient Greece, as this *Pluto* of the South was the Lord of Bulu, which is called in some of the Islands *Pulotu*, a coincidence in names which has already attracted the notice of our Missionaries.[41] In Japan he appears to have preferred a permanent residence on earth to his monthly visits in November, and accordingly assumes the form of the divine *Mikado*, who receives the Kamis, the deified spirits of the dead, as guests for the space of one month, the *mundus patens* and "the month of fear" of the Japanese. "All the kamis or gods," we are told, "are held annually to wait upon the *mikado*, and to spend a month at his court. During that month, the name of which implies *'without gods,'* no one frequents the temples, believing them to be deserted." [42]

The Pluto of the Pacific Islands, like too many emigrants, seems to have met with sad disasters in his wanderings to the north. He appears in time to have been robbed of all his attributes that were worth having, and to have been left only the unenviable perquisite of presiding over Hades, and the doubtful reputation of having caused the deluge. Egyptologists have discovered that *Baba*, or Typhon, was, after a long reign, dethroned, that his name has been erased from the monuments, and that he has come down to posterity as "the *principle of evil*." [43]

Even his matrimonial relations with the little damsel wedded to him in the South, appear to have been unhappy. In Greece he had the reputation of having forcibly abducted and married a minor, who insisted on returning to her mother for six months in the year. In India she seems to have completely cast him in the shade, and to have robbed him of most of his honors and his worshippers. In Egypt matters were still worse. She not only left him for another, but also accused him of having been the death of her second spouse.[44] The ceremony of "bathing the

[40] As the Eve of All Saints is more generally observed north of the Tweed than in England, I have throughout made use of the Scotch name *Halloween*, instead of Hallow eve. It is worthy of note, however, that there are some parts of Scotland in which Halloween is held on November 2nd.

[41] Turner's Polynesia, p. 88, 237.

[42] Japan and the Japanese in the Nineteenth Century, p. 143. See also ante, p. 57.

[43] See Bunsen's Egypt, i. 412, 417. Wilkinson's Manners and Customs of the Egyptians, i. 330.

[44] There can be but little doubt that Set or Typhon was the primitive Osiris and hence originally the husband of Isis; and that Osiris was a development of the primitive myth. This view will be borne out by a reference to Bunsen and other Egyptologists.

god," once performed in his honor, was converted into a scandal against him, and was fabled to have been in memory of his having cut up his rival into pieces, which he enclosed in an *ark*. It is certainly full time that justice should be done to this benevolent and much maligned Divinity.

But in Greece we have not only traces of the annual commemoration of the dead, but also of the form in which it is to be found in America, and which certainly appears to be the more primitive and even ancient mode of observance. Almost everywhere this commemoration was accompanied by games, and was *nocturnal*. But the funeral rites and games of the American Indians, celebrated every eighth or tenth year, appear in the great games of ancient Greece, and in the Eleusinian mysteries. Plutarch says the former were originally held at night, and appear to have been originally the same as the mysteries. The Olympic, Isthmian, and Eleusinian games, celebrated every fifth year, were all funereal.[45] The victor was crowned at night. A festival of the dead invariably preceded the Olympic games; and at the Isthmian, the judges were dressed in mourning, and the crown of victory was a wreath of funereal parsley, the ancient type of the modern black crape hat-band. As the Isia were annual, and the Eleusinia[46] were only celebrated every fifth year, the latter appears to have had their origin in the more ancient form of the festival of the dead, and not to have been derived, as has been supposed, from the Egyptian mysteries of the Isia.

But the most striking contrast (one with which I shall conclude these remarks, on this point, which might be expanded into a volume), is that presented to us by the Yucatan Indians. On the second of November they combine the old native ceremony of "carrying the dead" with the modern rite of saying mass for their souls. The skulls of deceased relatives, carefully preserved, are brought out on that occasion; and a peculiar food for the dead, called Mukbipoyo,[47] is left by the natives for the use of the hungry manes, on the *very same day* that our rustic "Soulers" beg for "a *soul cake" for all christian souls*.

I have ventured to designate the *universality* of the Festival of the Dead, its connection with the primitive year, and the coincidences in the times when it is observed in different portions of the globe, as "new materials for the history of man." The *antiquity* of many popular customs has always been known and

[45] Fast. Cath., i. 178, 617. The latter were sacred to "Grief," and the Olympic games were held on days that were *"stained* by death." See ante, p. 73.

[46] See Incidents of Travel in Yucatan, i. 44, 123, 430. Also note to p. 12.

[47] See note to p. 14.

acknowledged. Many of the matters I have referred to, have from the days of Herodotus to the present time been the subject of ingenious speculation and of profound research. Brand, Sir Henry Ellis and other learned English writers, have collected much interesting and curious information on the subject. In Germany, Grimm and others[48] have turned their attention to the antiquity of the popular observances of Indo-European races, and have attempted the arduous task of tracing them back to the homes of our Aryan ancestors. But is it not possible that they have commenced their explorations at the wrong end of the subject? If all men are descended from a common parent, and there is innate in human nature such a marvellous tendency to cling to the observances of the past, we may be sure that this peculiarity will be far more conspicuous in the unchanged, and almost unchangeable savage, than among civilized nations; and hence that it is among primitive and rude races, that we must seek for the scattered relics of primeval society.

Though the brook may in time swell into a river, it is very easy to follow it downwards to the sea, but to retrace its course from the ocean may be a most difficult task. Had the savages of Central Africa felt the same curiosity as to the mouth of the Nile, that we have as to its source, the mystery that has so long existed would ages ago have been removed. To trace the popular customs and superstitions of European nations up to their origin, is a most arduous undertaking. A bewildering labyrinth lies before the student, as he attempts to explore the maze of myths, customs, and superstitions that have grown up in rank luxuriance in civilized communities; and that are the accumulated productions of many centuries, and of continual changes in modes of thought.

What is primitive is so small a portion of what appears equally ancient, and is so disguised by the changes which time has produced, that the student must often find around him much that is highly interesting and curious, but nothing that is sufficiently definite to form the basis of historical reasoning.

I commenced in 1853 to pursue an entirely different mode of investigation, viz.: by instituting a *comparison* of the customs and superstitions of nations. In the first instance I entirely disregarded the traditions and myths of civilized nations and of antiquity, as more likely to lead one astray than to aid my investigations, merely striving to ascertain what customs and festivals are to be found in Europe, Asia and America. The next step, after having discovered the existence of *universal* festivals or customs, was to see how they were observed among savage races. Having once established this starting point, I made use of what

[48] I much regret that I have been unable to procure their works.

I believed to be the primitive type, as a guide to the more developed form which each custom or festival had assumed among the civilized nations of ancient or modern times.

I make these remarks in consequence of having recently received from an eminent Philologist, a letter, in which he advises a different course of enquiry from that selected by myself.

"I have no doubt that a comparative study of the customs of ancient and modern nations, will lead to results as interesting as those already arrived at by a comparative study of languages. The field no doubt must be much enlarged, and at first the customs of the great well-established families of mankind should be explored separately, just as we have to work out first a comparative grammar of the Semitic, Aryan and Turanian nations, before we can approach the problem of a possible community of origin of these distinct families. I should consider a collection of the customs and traditions of savage races particularly important, care being taken to separate anything that could be adventitious from the original stock of their folk lore."

I would, however, suggest whether the science of *ethology* (as I have ventured to designate the study of the customs and festivals of nations) will not open up far more abundant materials for the history of man than comparative philology; and hence whether the former need be restricted within those limits, beyond which science has been unable to trace affinities in the languages of Europe and Asia.

It is possible that, if there are universal festivals and customs, traces of the primeval language may be found in connection with them.

When we find the *Tau* of Polynesia in countries so widely separated from each other, and the Cemis, the household gods of the West Indians, appearing in the *Cemis* of Yucatan, the *Kamis* of Japan,[49] *Kaimis* of Egypt, and in *Kamise*, the ancient Diana or Hecate of Italy,[50] the idea does not appear so very improbable. But whether there can ever be traces found of the primeval language of mankind or not, there can be no question that in the Festival of the Dead we have a relic of the social and religious life of primitive society, and in the year of the Tau or of the Pleiades, a memorial of its calendar.

The paper to which I have made such comparatively voluminous additions was unavoidably, as has been stated, very hastily prepared, and was published in the transactions of a Colonial Scientific Society. The addenda have been privately printed in forms of eight pages, as I found leisure to make further investi-

[49] Bunsen, i. 435.
[50] Orig. Kal. Ital., i. 360, 377.

gations: and several months had elapsed before the materials collected and printed had assumed their present dimensions. I mention this, as it will explain any slight inconsistencies or modifications of my views that may be apparent, and will afford a reason and an excuse for some repetitions, that were almost unavoidable. This circumstance, while it exposes the paper to criticism, to some extent affords a test as to the general correctness of the conclusions to which I have arrived, as each form is a confirmation or otherwise of that which precedes it. The portion as to the progressive character of the year of the Pleiades, and its effect on ancient calendars and festivals, was worked out after the paper on the Festival of the Dead had been published.[51] Unless some evidence could be adduced to show that ancient calendars were progressive in relation to the seasons, a view not hitherto entertained, the connection of the festival of the dead with the year of the Pleiades would be rejected *in limine,* as altogether inadmissible. Hence, under every disadvantage from not being able to procure assistance from others, I have been compelled to enter into a question of no ordinary difficulty, and necessarily in a manner that has not done justice to the subject. Still enough has been shown, I hope, to induce more competent enquirers to explore a field the existence of which I have merely attempted to indicate.

An author who has turned his attention to the study of customs has written to me to say that, if a connection could be established between the customs and superstitions of the Old World and those of America, *"it would be a most startling discovery."* This point, which I believe I have proved beyond any question, will, I trust, be a sufficient apology, if all my other assumptions are regarded as inadmissible by the learned.

If I have not proved satisfactorily that the Festival of the Dead among the Australians, the Fijians, the Sandwich Islanders, the people of the Friendly Islands, of Peru, Yucatan, Japan, China, India, Persia, Ceylon, Russia, Lapland, ancient Egypt, Greece and Rome, was the same as our All Halloween, All Saints, and All Souls, I shall be able to do so hereafter, when at greater length I shall be able to treat of the origin of the festival, and of the various customs connected with it, that are to be discovered wherever it is celebrated. It will yet be found that the festivals and customs of nations are far more ancient than the oldest monuments and the most time-honored deities; and that the new year's commemoration of agriculture and of the dead long preceded and

[51] Most of the materials in the addenda have been the result of investigations since the paper itself was printed, excepting that portion relative to the customs of the North American Indians.

will long survive the divinities and the myths to which it has given birth.

At a time like this, when the human race seems to be striving so earnestly to solve the mystery of its origin; when science points on the one hand, to the links that connect us with the brute creation, and, on the other, to the distinct and apparently unchangeable "types of man," that separate the Australian, the African, and the American, so widely from the European, anything, however trivial, that may tend to show that all the races of mankind belong to one common family, can scarcely be regarded as uninteresting or unimportant.

The labors of Professor Max Müller and of other philologists have accomplished wonders, but have not yet succeeded in disclosing the long sought for elements of one common primeval language. Science has not yet refuted the conclusions of Agassiz and of American Ethnologists, that the various "types of man" owe their origin to different "centres of creation." To controvert their views, we may have to turn, not to the silent monuments of remote antiquity, but to those living memorials of our race that are preserved in the customs and festivals of nations.

It would not be a little remarkable, if those three days consecrated in India to "the memory of the *Pitris*, the progenitors of the human race," should prove to be a link to unite their descendants together, and to be at once the evidence and the commemoration of a common origin.

If it be true that we have sprung by development from the brute creation, it is plain that the transition to humanity must have been very rapid and very decided, as the Feast of Ancestors, inherited by all nations from primeval man, is a touching tribute of regret from the living to the dead, and is clearly based on a belief in the immortality of the soul.

To be concluded

MEETINGS OF THE SOCIETY

At Toronto

November 2, 1920.—The Society met in the Physics Building of the University at 8 p.m., the President, Mr. J. R. Collins in the chair.

Mr. J. B. Russell, University of Toronto, was elected a Member of the Society.

The Paper for the evening was given by Mr. A. R. Hassard, on "The construction of a reflecting telescope and its revelations." Mr. Hassard described minutely the process of constructing a reflector, and exhibited a mirror he had made having a diameter of 7 inches and a focal length of 65 inches. He also described very interestingly the chief celestial objects to be studied with such a telescope.

November 16.—The Society met in the Physics Building of the University at 8 p.m., the President, Mr. J. R. Collins, in the chair.

Several members reported observations they had made upon the partial eclipse of November 10th. Mr. A. F. Miller projected the image of the sun upon a screen, so that a number of people could view the eclipse at the same time. The President made a similar observation, using a pair of field glasses mounted on a tripod. Prof. C. A. Chant showed a few photographs taken with the 4-in. equatorial telescope of the University.

A magnificent picture of the total eclipse of the sun, June 8th, 1918, was exhibited by Prof. Chant. This picture, drawn by Mr. Butler, a New York artist who observed the eclipse, is accepted as one of the best representations of the corona and prominence yet produced.

Prof. C. A. Chant gave the paper for the evening, his subject being "The measurement of the wave-lengths of light." The lecturer first discussed light as a wave phenomenon, explaining the chief features of waves in water, air, and the ether. By means of diagrams he showed how interference fringes are produced, and many of the laboratory experiments which demonstrate this principle were mentioned. A grating, having 3001 lines to the paris inch, made from one by Nobert, was displayed, and its effect upon a ray of light explained. The relation connecting wave-length, element of grating and angle of diffraction was obtained; and the wave-length of sodium light was then measured, using only a screen with a slit in it, the grating and a metre rod. The value secured was 0.000590 mm. Many were surprised at the very simple means used and the accurate result.

November 30.—The Society met in the Physics Building of the University at 8 p.m., the President, Mr. J. R. Collins, in the chair.

The paper for the evening was given by Prof. G. R. Anderson, of the University of Toronto, on the subject: "Landmarks in Photography." The lecturer traced the development of the art of photography from the Middle Ages to its present state of perfection. The alchemists, searching for the philosopher's stone

and the elixer of life, discovered the germ of photography when they found that light affected the salts of silver. The Italian Porta, in the 16th century, invented the camera obscura, or pin-hole camera. Later he replaced the pin-hole by a lens, and using a mirror produced erect pictures on a screen. In 1802 an Englishman, Wedgworth, experimenting with silver salts, formed an image on paper, but could not fix it. He searched for years for a fixer but failed to get a solution. Niepce, a French scientist, was the first to get a process of photography which gave pictures subsequently unaffected by light. He coated the surface of a metallic plate with a solution of asphaltum in oil of lavender, and exposed it. After an exposure of twelve hours, the parts unaffected by light were dissolved away by immersing the plate in a solution of oil of lavender and white petroleum. This is the first landmark. In 1834 Fox-Talbot obtained images of objects on paper, by placing the object, such as a fern leaf, upon a sensitive paper and exposing it to the light. He fixed his picture by means of a salt solution. By his process he obtained a photograph in one hour. In 1841 by using more sensitive paper he obtained pictures with the camera.

In 1839 Daguerre announced his discovery. Exposing a highly polished surface of metal such as copper to the vapours of iodine he obtained a sensitive surface. To develope his plate he exposed it to the vapour of mercury which condensed on the surface acted upon by the light and formed an amalgam. Daguerreotypes were very pop ular in the middle of the 19th century, but they were not always complimentary, as the subject was forced to sit for 15 minutes in the sunlight, and consequently often closed his eyes. In 1855, Daguerre, not satisfied with his method, tried to develope a sensitive glass plate instead of paper. Archer produced the wet plate process, using a solution of collodion and silver. This process had the disadvantage that the plate was not sensitive when dry. Thus a new problem presented itself—to make a sensitive dry plate. Dr. Maddox, in 1875, using gelatine, succeeded in obtaining the dry plate, and this step may be regarded as the second landmark in the development of the science.

Orthochromatic and panchromatic plates were produced in the seventies. In 1890 when the celluloid film replaced glass plate we have the advent of the Kodak which has popularised photography. Muybridge in California in 1877 using a number of cameras in a row obtained a series of photographs of a horse in action. This idea was developed by Marey in Paris, who invented the first moving picture machine in 1893. Since then moving pictures have been brought to a high degree of perfection. A large number of slides were shown illustrating every phase of the art mentioned by the lecturer. Daguerreotypes and pictures obtained by the various processes were passed and examined by the members.

December 14.—The Society met in the Physics Building of the University, at 8 p.m., the President, Mr. J. R. Collins, in the chair.

The paper of the evening was given by Prof. J. Satterly, of the Dept. of Physics, his subject being, "Planimeters, and the Measurement of Areas."

The lecturer first explained the simple rules for measuring areas, such as those formulated by the English surveyor Simpson, and later by Weddle. He then

displayed three types of planimeters, the Hatchet, the Amsler and the Rolling Sphere, the latter two being constructed by Coradi of Zurich, Switzerland.

A number of Hatchet Planimeters, made in the workshop of the Physics Building and used by the students of Prof. Satterly's classes, were passed to the members and examined. Prof. Satterly explained their manufacture and developed the theory of the instrument. The area equals the product of the arc traced out by the hatchet and the length of the planimeter. This is a first approximation and has an error of 2 to 3 per cent in excess of the true value. A closer approximation is obtained by summing the area first in one direction, and then in the opposite direction and taking the mean value. This value is within 1½ per cent. of the true value. It is essential that the starting point be as near as possible to the centre, which perhaps is a weakness of this instrument.

The Amsler Planimeter, although much more complicated in construction, is in theory, the simpler of the two. The area traced out by the moving point is recorded on two small dials which are operated by wheels mounted mutually at right angles. As a motion in any direction may be resolved into two simple motions in directions at right angles to each other, all motions of the point are recorded by the dials, and the area traced out is ascertained directly by reading the dials before and after the operation. The accuracy of the instrument is within one per cent. The Rolling Sphere Planimeter is another type of the Amsler, being constructed on the same principle. The value obtained by using the Hatchet Planimeter, is in general within ½ per cent. of that obtained by using the Amsler, so that for a quick approximation the Hatchet is usually employed. When accuracy is desired the Amsler is used.

The lecturer gave an interesting demonstration of these instruments by finding the areas of certain geometrical figures, and other areas of unusual shapes. He emphasized the importance of the planimeter in analysing those curves peculiar to the work of the engineer, surveyor and the astronomer.

J. A. Pearce,
Recorder.

At Victoria

November 24, 1920.—Prof. S. L. Boothroyd addressed the Centre on "Our Moon and Other Moons". He began by stating that more effort and time has been devoted to the study of the motions of the moon than to any other science, and the benefits derived therefrom have been of inestimable importance to science as a whole. These lunar observations have continued from the earliest dawn of history; and to-day geologists, geographers and astronomers themselves owe an immense debt of gratitude to the lustrous orb as a source of invaluable information. Geographers, for instance, have found that the best method of fixing the exact position of terrestrial points is by means of calculations involving the moon. In further exemplification, he declared that this body has afforded us a test of Newton's Law of Gravitation, the accuracy of which far transcends that of any other constant that has yet been discovered.

Unlike the Earth, erosion had played no part in shaping the topography of the Moon, whose surface had been determined largely by volcanic agencies. In the lecturer's opinion, the theory that the many craters visible on the latter body have been caused by the impact of meteors is one very difficult to be supported. At this point in his discourse, Prof. Boothroyd remarked that a modest telescope of from six to ten inches was even more efficient for the study of the Moon than the photographs of the largest instruments available for that purpose. This he hoped would prove encouraging to amateur astronomers.

Later, in his discussion of the planets, the lecturer exposed the fallacy that Jupiter with its galaxy of nine moons must enjoy better nocturnal light than the Earth with its sole contributor, by declaring that the intensity of the Jovian moonlight was only five-ninths of that which we enjoy. He also corrected the popular impression that our Moon appears larger at the horizon than at the zenith ascribing it to an illusion of increased distance from comparative objects when at the latter point.

K. M.C.

NOTES FROM THE METEOROLOGICAL SERVICE

Summary Report of the Weather for November, 1920

Temperature—The temperature was above the average from the British Columbian Coast to the boundary of Manitoba. In Ontario it was from average to 2 degrees below, in Quebec from 1 to 3 degrees below, and in the Maritime Provinces from 2 to 4 degrees below. The chief positive departures were experienced in parts of Alberta and Saskatchewan and varied from 6 to 7 degrees.

TEMPERATURES FOR MONTH OF NOVEMBER, 1920

STATIONS	November Highest	November Lowest
Yukon		
Dawson	42	−20
British Columbia		
Atlin	48	6
Agassiz	61	25
Barkerville	42	6
Kamloops	52	11
New Westminster	54	28
Prince Rupert	53	32
Vancouver	54	31
Victoria	58	35
West Provinces		
Battleford	55	2
Calgary	56	− 4
Edmonton	54	3
Medicine Hat	57	− 1
Minnedosa	42	2
Moosejaw	49	− 6
Oakbank	46	0
Prince Albert	50	0
Qu'Appelle	46	− 9
Regina	48	− 9
Saskatoon	42	1
Souris	53	− 2
Swift Current	54	− 8
Winnipeg	46	0
Ontario		
Aurora	57	15
Bancroft	74	3
Barrie	53	14
Beatrice	51	0
Bloomfield	55	15
Chatham	62	20
Clinton	57	12
Collingwood	63	15
Cottam	66	5
Georgetown	57	14
Gravenhurst	53	8
Grimsby	60	18
Guelph	58	14
Haliburton	51	0
Kenora	41	5

STATIONS	November Highest	November Lowest
Ontario—cont.		
Kingston	55	20
Kitchener	57	14
London	60	18
Lucknow	54	2
North Gower	55	7
Oshawa	61	27
Ottawa	52	13
Paris	61	17
Parry Sound	54	8
Peterborough	57	15
Port Arthur	42	− 1
Port Burwell	57	19
Port Dover	60	20
Port Stanley	57	16
Queensborough	54	10
Ronville	53	9
Southampton	54	5
Stonecliffe	46	− 4
Stoney Creek	63	21
Toronto	62	20
Uxbridge	52	15
Wallaceburg	59	20
Welland	59	21
White River	45	− 8
Quebec		
Brome	51	4
Father Point	45	4
Montreal	50	12
Quebec	44	6
Sherbrooke	48	11
Maritime Provinces		
Charlottetown	60	18
Chatham	60	0
Fredericton	58	− 9
Halifax	60	18
Moncton	62	9
St. John	57	14
Sussex	58	− 4
Sydney	58	16
Yarmouth	60	24

Precipitation—The precipitation was above the average over most of that part of Ontario south and east of Lake Huron and the Georgian Bay to the Boundary of the Province, also very locally

above in Manitoba, otherwise over the Dominion it was below the average. In British Columbia the deficiency varied from three inches in parts of Vancouver Island, to three and six-tenths of an inch in the Interior of the Province. In the Western Provinces the amount was nearly everywhere much below the normal. In northern Ontario it fell short of the usual quantity by from half an inch to an inch and a half. In Quebec by from half an inch to an inch, and in the Maritime Provinces from three-quarters of an inch to an inch and three-quarters.

Magnetic Disturbances, October, 1920

At the Agincourt and Meanook Observatories the Magnetic Forces during the month of October 1920 were for the most part quite normal. The only disturbance of note occurred on the 9th and 10th. It began gradually during the afternoon of the 9th, the Force gradually diminishing to a minimum at 1.05 of the 10th, and then gradually returning to normal during the morning of the 10th. The Declination was also sluggish at Agincourt, but at Meanook the movements at times were large and rapid.

The ranges in the various elements were as follows: Agincourt: H, 415.5γ; Z, 194.6γ; D, 62′.9; Meanook: D, 191′.8.

Several sun spot groups were observed during the month, the most active being central north of the equator on the 9th, others were central on the 16th, 24th, 25th, and 26th, and were composed of many small spots.

An aurora of the first class was reported from all parts of Canada on the 9th. During the rest of the month reports were infrequent.

W. E. W. J.

Seismological Notes for November 1920

During the month, Toronto recorded seven disturbances and Victoria, five. The majority were of small amplitude. This is about the normal number for November which Toronto should record. The largest of the month was recorded on the 16th. The P waves at Victoria came in at 8h 36m 20s, G.M.T., and the S at 8h 40m 15s. In Toronto the P waves were not recorded, and the S was registered at 8h 44m 12s. Victoria gives a trace amplitude of 2.5 mm. against 1.2 mm. for Toronto. The approximate position of this epicentre was Latitude 26° 24′ N, Longitude 115° W, 2380 km. from Victoria.

J. Y.

ASTRONOMICAL NOTES

A New Feature

In the present number is begun the publication of a series of brief reviews of interesting and important papers appearing in the different scientific periodicals.

It is intended that these short articles shall contain a clear outline of the matter given in the original paper expressed in language which the ordinary amateur can understand. They will be prepared by a number of persons engaged in astronomical work, and it is hoped that the readers of the JOURNAL will in this way be enabled to keep in closer touch with developments in the domain of astronomy.

Herewith are three contributions by Mr. Henroteau, of Ottawa, in which two articles of French and one of Belgian origin are summarized.

BRIGHTNESS OF THE ECLIPSED MOON AND SOLAR ACTIVITY

Sur une relation entre l'éclairement de la Lune éclipsée et l'activité solaire par *A. Danjon* (*C. R.*, 1920 December 6, p. 1127). The author shows that:

(1) During the two years which follow a minimum of solar activity, the earth's shadow on the moon is very dark, gray or very little coloured.

(2) Then, the more we recede from the minimum of solar activity, the moon is brighter during the eclipses and its colouring is more red. During the three or four years which precede the following minimum, the eclipsed moon is very bright, reddish brown or orange.

In other words, the variation of brightness and of colouring of the eclipsed moon is a function of the variation of solar activity; the above law is based on the observation of 70 eclipses from 1823 to 1920. In determining the law of variation, three consecutive eclipses (observed in 1889) have been omitted, for in these eclipses the moon was dark instead of bright; their abnormal darkness, however, was attributed to the suspension in our atmosphere of great quantities of dust particles, following the tremendous eruption of Krakatoa.

F. H.

PERIOD OF SOLAR ACTIVITY

Nouvelle détermination de la période solaire basée sur la loi d'éclairement des éclipses de Lune par *A. Danjon* (*C.R.*, 1920 December 13, p. 1207). From descriptions of lunar eclipses as far back as 1583, the author obtains the years in which minima of solar activity occurred. It is to be remembered that the regular observations of variation of numbers and intensities of sun-spots is scarcely one century old, which is too short a time to furnish us reliable results as to the law of variation of solar activity. Danjon's work is therefore of the greatest value, giving us good results as far back as 1583, with the possibility of being extended to much older times. Not only did Danjon find out that the best formula to represent the minima of solar activity is:

$$\text{min.} = 1584.8 + 10.87E, \quad (1)$$

E being a whole number, but he found a secondary oscillation in the variation of solar activity, having a period of 136 years. This furnishes a periodic term to be added to equation (1) and which makes it

$$\text{min.} = 1584.8 + 10.87E + 1.7 \sin 2\pi\ (l - 1608)/136,$$

where l is the date of the mean minimum as derived from equation (1).

Danjon predicts the date of the next minimum of solar activity to be 1923.4.

F. H.

AN IMPROVEMENT ON EINSTEIN'S THEORY

Théorie nouvelle de la Gravifique, par Th. De Donder et H. Vanderlinden (*Buletins de la classe des sciences de l'Académie Royale de Belgigue*, 1920, p. 232-245).

In the actual Einstein's theory of gravitation, the total force generalized is always zero; according to this, it is almost impossible to construct a stable electromagnetic system devoid of matter. In other words, in Einstein's theory of gravitation no purely electromagnetic atom would be possible.

The authors have succeeded, while conserving Hamilton's principle as generalized by Lorentz, in modifying Einstein's system of equations in such a way, that the total force generalized is not everywhere zero. For this purpose they utilize new potentials $\gamma^{\alpha\beta} \equiv g^{\alpha\beta} \sqrt{-g}$.

In the new theory, the gravitational equations are simpler than those of the former theory and allow us to demonstrate new and interesting theorems. In it, the generalized force is expressed by the relation $F_i = d\Gamma/dx_i$ (with $i = 1, 2, 3, 4$), Γ being the function which rules space-time, $\Gamma = (2a + kC)\sqrt{-g}$; a and k are universal constants and C is the invariant of total curvature.

The theory developed by the two Belgian scientists transforms and greatly simplifies Einstein's theory of gravitation and constitutes an important step forward in that new field which at present tends to revolutionize completely our conception of the Universe and of its general laws.

F. H.

NOTES AND QUERIES

Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries

Tests for Resolving Power

(By J. R. C.)

Mr. F. Kerr, of Alexandria, Ont., writes that in testing his 4-in. telescope for separating, or resolving, power he has found that some of the double stars cited as test objects and described as difficult to separate with a 4-in. aperture are easily separated, whilst others described as easy are really difficult.

Delta Cygni, for instance, is stated by several authorities to be difficult with an aperture of $8\frac{1}{2}$ inches, yet he finds it easy with a 4-inch. In regard to this object Mr. A. F. Miller remarks: "The reason for the difficulty is obvious, since both the distance and the brightness of the companion vary in the course of years. Herschel measured the pair in 1783 as 2″.5; later, on several occasions he was unable to see the small star with his powerful telescope".

Epsilon Arietis is a binary system, the distance changing from 0″.5 to 2″.

Zeta Herculis is an occulting binary, with a period of 35 years, and is of course variable.

Regarding 20 Draconis, Burnham in his *General Catalogue of Double Stars*, published in 1906, says that for more than half a century after the discovery of the pair by Herschel in 1783 it was readily measurable with telescopes of moderate aperture. The distance has been slowly decreasing, and for the last 20 years it has been beyond the reach of all but the largest refractors. Early in the 19th century the distance was 0″.7, now it is 0″.3.

With regard to Delta Cygni, which is numbered 9605 in this catalogue, Burnham states that there has been little change in the distance, and it will probably be necessary to observe it for another century to get the necessary data to determine the apparent and real orbits. Many of the measures have large obvious errors both in angle and distance, and should be rejected in any future investigations of the orbit.

It will be apparent from the above that to be of value as tests for resolving power the periods of these objects and their separation should be known at the time of observation.

Reproductions of the Moon for Sale

Some years ago Mr. Henry Harrison made a good painting of the moon from direct observations in the telescope, and at considerable expense had lithographic copies made of it. The age of the moon is about three days, and the plates are about two feet square. Mr. Harrison is now becoming advanced in years and would be glad to dispose of the copies still on hand. The price is $1 and copies may be obtained by addressing the office of the Society, 198 College St., Toronto, or directly from the painter, at 165 Clinton Ave., Jersey City, N.J.

A Young Moon Seen Overhead

In the *National Geographical Magazine* for January, 1921, is an extended article describing the voyage of a very small vessel, named the "Dream Ship", from the south of England through the Panama Canal and almost across the Pacific Ocean. About midsummer it arrived at the Galapagos Islands, which are just at the equator. Describing his experiences one night the writer says: "The trade wind had fallen to a stark calm, and the "Dream Ship" lay wallowing on an oily swell. A young moon rode clear overhead, and myriads of stars gazed down at us".

BRIGHT EVENING STAR

Beyond my grasp full well I know thou art,
Bright evening star;
And yet thy radiance fills with joy my heart,
As from afar.

Your heaven-lit lamp, at eventide aglow,
Seems full of love,
And lures us not to dwell on things below,
But look above.

—Christina Partridge, Brockville,
in *Mail and Empire*.

C. A. C.

The Royal Astronomical Society of Canada

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